We Claim:

1. A real time method for estimating of the conditional probability distribution for the current and future state of a non-linear random dynamic signal process, the method comprising:

providing measurement sensing of sampled data associated with then state of said signal process at sampled instant of time *t* under consideration,

creating state data for particles that probabilistically resemble the state of said signal process,

calculating branching values for each of said particles of state data at each new instant of time, sampled data is provided by said sensors,

selectively duplicating the state data of said particles' data in accordance with branching value criteria,

selectively deleting the state data of particles of said sampled data in accordance with branching value criteria, and

undertaking in accordance with said branching value calculations, the following actions:

scaling said branching values with measurement noise so as to reduce the duplications and deletions of state data as the effect of the measurement noise increases,

dividing the collection of said particle state data by the number of particles to provide the estimate of a conditional probability distribution of said signal process at the time of the most recent measurement preceding a request for said distribution and probability.

repeatedly computing estimates of said conditional probability distribution based upon the arrival of new sampled data at subsequent sampled instants of time $t + n$.

2. A method as claimed in Claim 1, wherein said method further comprises: estimating the joint conditional probability that said signal process will be represented by any set of possible paths at various past and current instants of time, and by employing sampled data obtained up to the current time to

estimate probabilistically said particle paths, by assigning the weight of one divided by the current number of paths to each of said paths.

3. A method as claimed in Claim 2, wherein the number of particles are re-normalized by selecting a random set of particle state data to either duplicate, or delete particles of said state data.

5. A method as claimed in Claim 1, wherein said method further comprises: storing state data for particle paths through use of ancestor particle state data where an ancestor particle represents a previous particle state and can be an ancestor to more than one particle due to branching,

associating state data with ancestor sampled data to store integer weight values for said ancestral sampled data, which are related to a given ancestral particle, wherein the integer weight represents the number of non-ancestral particles, which are related to said given ancestral particles.

incrementing or decrementing the integer weight for the state data of ancestor particles of sampled data, in accordance with the number of related non-ancestral particles, and

deleting any ancestor particle of sampled data which has a weight of zero.

6. A method as claimed in Claim 5, wherein intermediate ancestor state data are generated at specific selected instances of time in order to facilitate the calculation of asymptotically optimal smoothing filters.

7. A method as claimed in Claim 6, wherein ancestor state data are discarded when the most recent measurement time is greater than a defined span of time from the creation of said given ancestor particle.

8. A method as claimed in Claim 7, wherein intermediate ancestor state data are generated at specific selected instances of time in order to facilitate the calculation of asymptotically optimal smoothing filters.